Improved hinge for electronic device

FIELD OF THE INVENTION

[001] The present invention relates generally to portable electronic devices.

BACKGROUND OF THE INVENTION

[002] Figure 1 shows a typical laptop computer **100**. Laptop computer **100** has a base portion **101**, which comprises a keyboard **106**, a central processing unit, and often data storage devices. A display portion **102** typically comprises a display screen **105**. The base portion and the display portion are connected by one or more hinges **103**. The display portion can be thought of as rotating about axis **104** of the hinge to open or close the laptop computer. Figure 1 shows the computer in the open configuration. In the closed configuration, display screen **105** and keyboard **106** are in close proximity, and the computer is substantially rectangular in shape. A laptop computer often contains at least one battery that enables the computer to be operated for a period of time without a connection to any power source external to the computer.

[003] The portability of a computer such as laptop computer **100** is an advantage to computer users who wish to be mobile, enabling them to work in remote locations such as job sites, automobiles, and airplanes. However, a remote location may not be configured for convenient use of laptop computer **100**. Figure 2 depicts laptop computer **100** in position for use by a person seated in airline seat **201**. Laptop computer **100** is placed on tray table **202** affixed to airline seat **203**. With laptop computer **100** in its open configuration, display portion **102** encounters the back of seat **203** at location **204**, necessitating that laptop computer **100** be moved toward the user, thus further limiting the already cramped space that the computer user, seated in

seat **201**, has for comfortably operating the computer. Other kinds of electronic devices, such as Digital Versatile Disc (DVD) viewers, personal digital assistants (PDAs), or dedicated word processors may suffer from the same difficulty.

SUMMARY OF THE INVENTION

[004] A movable portion of an electronic device is attached to a base portion of the device by a hinge mechanism that enables an edge of the movable portion to translate as the movable portion is rotated during the opening of the portable electronic device. In one example embodiment, the hinge mechanism comprises a groove in the base portion, a guiding feature on the moveable portion that engages the groove, and a link attached to both the base portion and the moveable portion of the electronic device, the link relating the motions of the two portions such that the electronic device opens as the guiding feature travels along the groove.

BRIEF DESCRIPTION OF THE DRAWINGS

[005] Figure 1 shows a shows a typical laptop computer.

[006] Figure 2 depicts the laptop computer of Figure 1 in position for use by a person seated in an airline seat.

[007] Figure 3 shows a laptop computer in accordance with an example embodiment of the invention.

[008] Figure 4 shows a partially exploded and partially cutaway view of the example laptop computer of Figure 3.

[009] Figures 4A and 4B show enlarged views of a portion of the example laptop computer of Figure 3.

[0010] Figures 5A - 5E schematically show partially cutaway views of the example laptop computer of Figure 3 in progressive stages of opening.

DETAILED DESCRIPTION

[0011] Figure 3 shows a laptop portable computer **300** in accordance with an example embodiment of the invention. Base portion **301** and movable display portion **302** of portable computer **300** are connected through a hinge mechanism **305** such that when the computer is in its open configuration, edge **303** of display portion **302**, the edge that is nearest base portion **301**, is displaced from edge **304** of base portion **301**. The following figures detail the workings of example hinge mechanism **305** that accomplishes this motion. Example laptop computer **300** incorporates two instances of hinge mechanism **305**, in mirror image. Like reference numerals indicate the same parts in the figures.

[0012] Figure 4 shows a partially exploded and partly cutaway view of computer **300**. In Figure 4, display portion **302** has been displaced so that more of hinge mechanism **305** is exposed for viewing and explanation. Figures 4A and 4B are magnified views of the area indicated in Figure 4. Figure 4B is shown from a reverse angle.

[0013] Referring now to both Figures 4A and 4B, shaft **402** is journaled in depending member **403** of display portion **302** of example laptop computer **300**. Distal end **404** of shaft **402** protrudes such that when display portion **302** is fully assembled to base portion **301**, engages groove **405** in base portion **301**. Distal end **404** thus provides a guiding feature that provides a constraint on the relative motion of base portion **301** and display portion **302**. Groove **405** may be formed into base portion **301** by any of a number of methods. For example, it may be molded into base portion **301**, or it may be formed as a cutout in a sheet metal insert in base portion **301**. One of skill in the

art will recognize other ways to form the elements of hinge mechanism **305**. Groove **405** has a centerline **407** equidistant from the two generally parallel sides of the groove.

[0014] Link **408** provides another constraint on the relative motion of base portion **301** and display portion **302**. Rear end **409** of link **408** attaches to base portion **301** at pivot **410**. Pivot **410** may be a shoulder screw, a stud, or another element providing an equivalent function. Forward end **411** of link **408** attaches to display portion **302** at pivot **412**, which is displaced in Figures 4, 4A, and 4B because the views are partially exploded. Link **408** is substantially rigid, and constrains base portion **301** and display portion **302** such that pivot **410** is a constant distance from pivot **412**.

[0015] When example laptop computer **300** is closed, guiding feature **404** rests near rear end **413** of groove **405**. As example laptop computer **300** is opened, guiding feature **404** travels along groove **405** toward forward end **414**. In the process, link **408** constrains the relative positions of base portion **301** and display portion **302** such that the opening angle between them is a prescribed function of the position of guiding feature **404** in groove **405**. During opening, depending portion **403** of display portion **302** sweeps through cavity **415** in base portion **301**.

[0016] Figures 5A - 5E schematically show partially cutaway views of example laptop computer **300** in progressive stages of opening, from fully closed in Figure 5A to nearly fully open in Figure 5E. Some features of example laptop computer **300** have been omitted from these views for clarity in showing the action of hinge mechanism **305**.

[0017] A user of example laptop computer **300** may wish to open the computer to a preferred viewing angle, and have display portion **302** stay in this preferred relationship to base portion **301** while still being adjustable with moderate effort.

Hinge mechanism **305** may comprise a friction-inducing device for facilitating this ability. Referring again to Figures 4A and 4B, gear **401** is fixedly attached to shaft **402**. Also formed in base portion **301** is curved gear rack **406**. Gear rack **406** has a pitch line (not shown) that is a substantially uniform distance from centerline **407** of groove **405**. A pitch line is a theoretical line along which the pitch of a gear is measured. Gear **401** engages and travels along gear rack **406** when distal end **404** of shaft **402** travels along groove **405**.

[0018] Gear **401** is fixedly attached to shaft **402** so that shaft **402** rotates as gear **401** travels along gear rack **406**. Spring **416** wraps around shaft **402**, exerting light compressing force on shaft **402**. Spring **416** comprises at least one tail portion **417**. Cavity **418** in display portion **302** is sufficiently large to contain spring **416**, and is generally cylindrical but for one flattened side **419**. Flattened side **419** prevents the rotation of spring **416** within cavity **418**. Because shaft **402** rotates and spring **416** cannot, friction is induced that resists the rotation of shaft **402**, holding screen portion **302** in a position set by the computer user. Spring **416** is thus part of a wrap spring friction clutch. The dimensions of spring **416** and shaft **402** are chosen such that the friction is sufficient to hold screen portion **302** in position, but to still enable the easy adjustment of screen portion **302**.

[0019] Other friction-inducing devices could be used within the scope of the appended claims. For example, shaft **402** could be a three-lobed shaft that rotates in a compliant, generally-cylindrical collar attached to display portion **302**. Alternatively, depending portion **403** of display portion **302** could contact a wall of cavity **415** on base portion **301** so that the sweeping motion of depending portion **403** is resisted by the friction between the two parts. An intermediate material could be chosen to provide the appropriate coefficient of friction.

[0020] While the invention has been described by way of example as embodied in a laptop computer, it may be embodied in other electronic devices as well. For example, a personal digital assistant (PDA) is a portable electronic device that enables a user to carry data and perform some computing applications, such as maintaining an appointment calendar and address book. Many PDAs comprise a base portion and a moveable display portion. The invention may be embodied in a PDA. Other kinds of electronic devices that may open and close in a similar fashion and could embody the invention comprise dedicated word processors, and dedicated viewers for Digital Versatile Discs (DVDs). A dedicated word processor may contain many of the components of a computer, but lack the general configurability of a computer, but instead be configured to enable a user to compose, edit, and print documents. A viewer for DVDs typically comprises a base portion comprising a mechanism that can read data from a DVD, and a display portion on which the contents of the DVD are displayed. Such viewers are often portable, and may be used to watch movies or other entertainment programming.